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ABSTRACT

Multimedia classroom technology provides a unique opportunity to augment the classroom experience. Coordinating instructional streams with student feedback and assessment will enable instructors to know when and if their intended message was communicated to their students. A system where both instructional and presentational aspects of a lecture can be evaluated promptly will permit instructors and students to react quickly when there is a gap between intent and understanding, improving instruction. Presented in this paper is a multimedia, e-classroom framework where information can be gathered to measure student, faculty and organizational achievement and to assist in improvement. Specifically, this paper focuses on using this e-classroom framework to improve instruction. (Contains 18 references.) (Author)

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Improving Teacher Effectiveness in e-Classrooms

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Abstract: Multi-media classroom technology provides a unique opportunity to augment the classroom experience. Coordinating instructional streams with student feedback and assessment will enable instructors to know when and if their intended message was communicated to their students. A system where both instructional and presentational aspects of a lecture can be evaluated promptly will permit instructors and students to react quickly when there is a gap between intent and understanding, improving instruction. Presented here is a multi-media, e-classroom framework where information can be gathered to measure student, faculty and organizational achievement and to assist in improvement. Specifically, this paper focuses on using this e-classroom framework to improve instruction.

Introduction

Many different factors influence whether a student has successfully attained learning objectives. Student performance is rarely homogeneous, resulting in the familiar bell-shaped distribution. Causes for poor student performance are hard to pinpoint. Poor student performance is, in general, due to many factors, which may include: study habits, including test preparation; prerequisite material understanding; attitude toward class, for instance, individual interest in subject matter or attentiveness to class progress; attitude toward instructor; compatibility between student learning style and instructor presentation style; and attitude toward learning. These factors significantly impact how well students understand the core concepts of a course and how many of the learning outcomes they will achieve.

A strategy needs to be defined and tools implemented to provide the instructor with prompt feedback and assessment. According to Reid, "Firstly, it is necessary to develop policy frameworks, quality processes, and online tools to provide comprehensive, timely, and appropriate information that can be acted upon in order to improve the quality of learning. Secondly, such frameworks, processes, and tools should be applied in flexible ways that reflect the nature of the learning environments that they are aiming to improve." (Reid 2001) This framework must demonstrate that the intended content has been delivered to the student and that the student has received it. Further, it must facilitate improved instructor effectiveness. The resulting impact, as seen in Curve 2 (Fig. 1), on student learning should be "A Significant Difference" (Russell 1999).

Educational assessment has multiple, distinct uses in instructional improvement including: school and student accountability for academic achievement, feedback for teachers to revise teaching and administrators to allocate resources, and stimulation for students to receive deeper understanding (Baker 1999).

In most cases, the main criterion for assessing student performance is the degree of subject matter understanding. Student performance is evaluated at irregular intervals, through graded homework, quizzes, tests, projects, and final exams. Too often, students who were confused during lectures would not find out how far behind they were until it was too late to catch up. It is during the classroom contact time that the instructor can exert the greatest impact on student learning. In fact, a study from the University of Tennessee found that teacher effectiveness was the dominating factor affecting student academic gain (Sanders 1997). Thus, it is important to assess learning in the classroom and let instructors take timely measures and make any necessary remedial changes.

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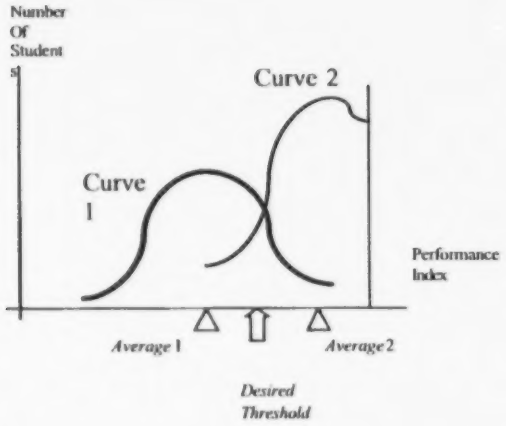

Figure 1. A Significant Difference

In terms of teaching evaluation, especially at the collegiate level, the burden of teacher and course evaluation falls upon the student using either in-class or Web-based survey forms. These evaluations are typically done only once, if at all. Since the survey is normally completed toward the end of the academic term, it does not impact students in the current class, though it may be helpful to future students in the same course with the same instructor. Also, since students may not take the survey seriously, the validity of the student response is questionable.

The important thing to note regarding the usual practices is that there is no correlation between student learning assessment and instructor teaching evaluation. Without timely feedback connecting student learning to instructor evaluation, neither the instructor nor the students have the power to affect change or to correct problems. Frequent feedback to the students advances student learning. According to Brien and Eastmond Cognitive Science and Instruction, "During instructional activities, the competencies taught must be reinforced each time they are adequately used by the learner." (Brien 1994) Further, Brien and Eastmond describe the "ideal" situation as one where the learner knows the final goal as well as the sub-goals that support the final goal. Therefore, it is important that learning outcomes be explicit and feedback frequent.

Not only is frequent feedback to the student important for effective learning, but frequent feedback is also important to the instructor for effective teaching. As Reid notes, "...it is vital that students can provide feedback wherever they are receiving instruction, in a fashion that is seamless with their learning environment." (Reid 2001) Ovando adds, "...researchers are conceiving of teacher evaluation as a mechanism for improving teaching and learning." (Ovando 2001) Further, "...teacher evaluations 'must analyze teaching on the basis of what students are learning as well as effectively integrate the teacher evaluation and staff development processes with school improvement...'" (Ovando 2001)

With the recent advent of powerful computer technology for delivering media-rich content in classroom settings, many new possibilities are now available for augmenting classroom instruction and learning. Much of the current research using technology in the classroom focuses on innovative ways to use finite classroom resources or to overcome other logistical difficulties. Examples include video learning (Anderson 2001), where courses are video taped as an alternative way to deliver course content; on-line classes, where courses are taught via intranet or Internet sites with bulletin-board and email interaction (such as WebCT (Goldberg 1997)); distance learning and other Web-Based Instruction techniques. Web-Based Instruction is defined both as a delivery medium (Khan 1997) and as a content creation tool (Relan 1997). Unfortunately, in its current state Web-Based Instruction emphasizes content creation (information) and ease of use rather than pedagogy and instruction.

Although many new methods are available, the different formats of material being delivered during lectures may overwhelm students, hindering learning, causing student disengagement in the classroom. A fully engaging classroom technology should leverage, capture, share, and allow others to participate in the experiences (Duffy 1996). Duffy states, "It does not make good economic sense to allow knowledge to evaporate." (Duffy 1996). It is important to "...demonstrate how captured classroom lectures can serve as one part of a rich and dynamic educational repository." (da Graca Pimentel 2001).

Research that focuses on getting more out of the classroom experience indicates that student needs and viewpoints have to be taken into consideration when course material is given in technology-based classrooms. (Hannafin 1996) As such, it is important for the instructor to know if and when the students are engaged so that proactive adjustments can be made. In summary, a system is needed for instructors to demonstrate they have provided the content and a feedback system for students to demonstrate that they have received it.

Approach: CaSA System Design

Networked computers or computing/PDA-based terminals are becoming widely available, so they should be used in classrooms to enhance learning through active interaction between students, the instructor and the material. To make use of this new technology, a new generation of instructional software is needed. A new framework, CaSA (Classroom and Student Achievement assessment), brings into focus the issue of matching teacher's goals and course objectives with students' learning and expectations.

CaSA is a flexible framework to augment the classroom experience by coordinating and synchronizing instructional streams, matching class plans to student class experience, and presenting instruction in a variety of media forms. Whereas many current e-classroom technologies augment course delivery or provide alternative means for delivery, CaSA will provide the means to assess and improve course delivery while providing alternative means for and augmenting delivery. The emphasis is on facilitating timely feedback, collecting assessment data, and offering alternatives to students with differing learning styles.

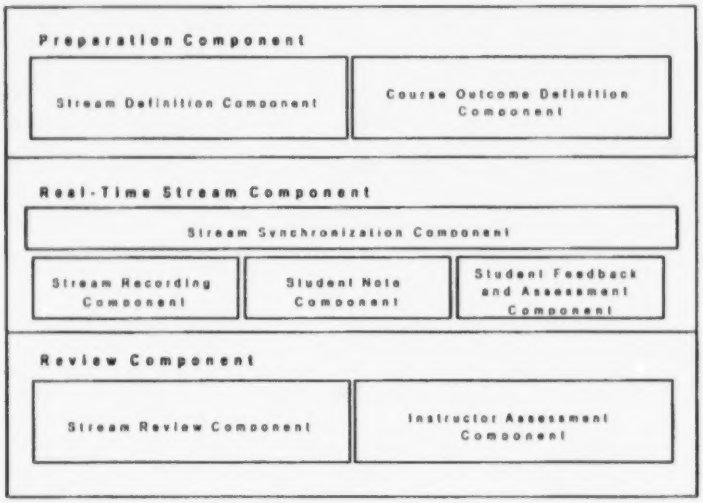

Figure 2 CaSA Component Diagram

The CaSA framework will consist of and coordinate three major components: a Preparation component, a Real-Time Stream component and a Review component (Fig. 2).

CaSA will support improved teacher effectiveness by providing immediate classroom feedback through collected student topic marking transmitted to the instructor as progress bars, periodic and frequent electronic concept questions both during and after class sessions, and instructional stream review and evaluation.

Pre-Classroom Preparation

Each lecture supports learning objectives from the course syllabus. Prior to the class, the instructor defines the lecture outline, covered topics, and the lecture notes (ClassPlan), which are associated with the text and course syllabus. The lecture consists of a ClassPlan presentation. As it is delivered, the various streams of presentation will be parsed into lecture segments, each of which is associated with a media type and descriptive

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labels, such as 'introduction,' 'concept,' 'equation,' 'illustrative example,' etc. derived from the ClassPlan. CaSA will also permit streams to be added or removed interactively. As instructor presentation formats evolve, CaSA will accommodate these changes to electronically capture the class session.

CaSA will capture the data required to support creation of concept maps from the ClassPlans, the covered topics representing core concepts. As instructors and students connect additional material to these core topics, the data available for the concept map grows. There are several ongoing efforts in the area of visually representing concept maps including work by Puntambekar, Stylianou and Jin at the University of Connecticut (Puntambeker 2001) as well as work by Aroyo, Dicheva and Velev (Aroyo 2001). CaSA will collect the data required for concept maps and will facilitate the use of concept map representational systems within an e classroom.

In-Classroom Interaction

During the e classroom experience, CaSA will coordinate instructional streams, assessments, and feedback and will electronically increase classroom interactivity. CaSA will connect classroom instruction to student feedback, collecting assessment data from student participation (topic marking, quiz and attitude testing), instructional streams, and instructor created course plans. Topic marking data can be used to provide instant feedback to the instructor and provide evidence that all required course topics have been covered during class sessions. Data collected from topic marking will not only be useful as to what topics were marked, but also when the topics are marked.

CaSA will electronically record the instructional content in its various forms, synchronizing the multiple instructional streams, as well as student feedback and assessment. It will provide context and valuable insight during assessment, instructor feedback, and student review.

The instructor's ClassPlan will be made available to students on their computing device at the beginning of each class session. This will accomplish three things. First, it will let the students know what topics will be covered, setting their expectations. Second, it will provide information needed for students to mark topics that will be covered. Third, it will document instructor intent which can them be compared to actual classroom experience.

As the class presentation proceeds, students will be able to indicate when they believe a specific topic has been covered. These marks will individually index the instructional streams. When they wish to review course material, the students can access the Web-delivered instructional streams based upon their individual marks. By allowing the students to use their individual marks to access course material, this system provides an incentive to mark topics as accurately as they can and serves to engage the students during the presentation.

As the students mark topics, CaSA will determine when and how many students believe that the instructor has covered a particular topic. This information will be made available to the instructor on demand as progress bars or via instant notifications based upon predefined thresholds. At a glance, the instructor can tell if students believe that a topic is or has been covered. If the instructor feels that he/she has presented a topic, but student thresholds have not been met, the instructor will know immediately and can make appropriate changes. The instructor will also be able to mark a topic as complete when a topic has been covered. Providing this feedback to the students will enable them to know immediately if they have missed important information.

Student topic marking also serves another purpose. Each student will be able to create personal links from personal material to course material, facilitating self-directed learning. By providing tools that assist students in retrieving, evaluating, comprehending and memorizing information while performing learning tasks the system will provide clear benefits. (Aroyo 2001)

CaSA will use the installed network of computers to permit the instructor to ask frequent, periodic questions to assess student understanding of the main concepts from the ClassPlan. Answers will be collected and immediate feedback regarding the overall state of student understanding can be presented to the student and the instructor. This will permit both student and instructor to take corrective action in a timely matter. In addition, reaction to and general attitude toward the material and class can be surveyed through positive and constructive questions during and at the end of the class.

Post-Classroom Review and Study

Stream review will be performed by students to assist in their self-directed learning, by instructors to critique and improve their material delivery, and by program administrators to insure that programs meet requirements. Also, independent evaluators can assess a course and by extension a program by sampling instructional streams and student topic marking data to verify that all the material necessary to support the course learning objectives was covered.

Questions from students are forwarded to the instructor through an intelligent FAQ (iFAQ). Replies to common questions that already have answers in the system's iFAQ are forwarded immediately to the student, while more elaborate or newer questions are sent to the instructor for a reply through email later. Each new question and its answer are added to the iFAQ and sent to the student automatically. The iFAQ assists both the instructor by filtering repeated questions and students by providing immediate responses to previously answered questions.

System Development

One goal of this system is to provide benefits to the instructor without putting a large preparation load on the instructor. The intent is to give an instructor an easy point of entry—minimal effort for maximum benefit. For example, by entering a course session outline into CaSA prior to a class session, the instructor will be able to publish the topics to students at the start of class, set their expectations for the class session, enable topic marking, stream synchronization and assessment stream data capture. All of this can be received by entering the topic outline, generally created during class preparation anyway, into the CaSA system.

The CaSA system is currently under development. Systems have already been created to provide adaptive learning and iFAQ (Gilbert 1999) and stream storage and playback services (from the UC Stream Media Group). However, these systems have not been integrated. Prototypes have been created to test student stream marking within a Windows Media Player stream and to integrate course topics with student notes.

Towards that end, the underlying software has been written using a layered approach to maximize reuse and interoperability. Figure 3 demonstrates a full communication cycle through presentation, client, clientRMI, serverRMI, server, and data base layers (Fig. 3). The plan is to have a working CaSA system with a sub-section of functionality available by the end of 2002. Additional functionality, including learning object support (Learning Object Metadata Working Group 2002) will extend CaSA in the future.

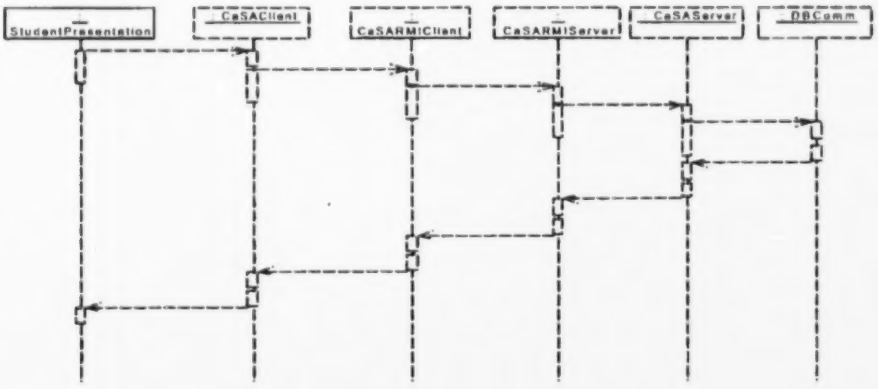

Figure 3: CaSA System Layered Communication Overview

Conclusions

E-classrooms, and CaSA in particular, provide a unique opportunity to augment the current classroom experience, aligning the expectations of students, instructors and institutions. Given a system where both instructional and presentational aspects of a lecture can be evaluated promptly, instructors, students and program administrators can react quickly when there is a gap between program requirements, course objectives and learning outcomes, between the intent of one and the understanding of another.

This framework will improve instructor effectiveness with prompt and iterative feedback, giving information and guidance regarding the kinds of educational materials and practices that most effectively enhance student achievement. It will also increase student engagement, providing an environment that produces demonstrable gain in student achievement.

By developing this framework within an eclassroom, information can be gathered to measure student, faculty and organizational achievement and to assist in improvement. Creation and implementation of projects

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such as this will track core learning topic coverage, connect course topic delivery with program and curricular goals, provide comprehensive assessment data streams, and produce tools, procedures and measures to assess student learning and achievement and the effectiveness of improvement efforts. Using technology to open clearly defined communication from students, instructors, and program administrators will close the gap from defined, delivered and received content and make "A Significant Difference" (Russell 1999).

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